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ABSTRACT

Among the articles in this newsletter are discussions concerning the employment of mathematicians in industry and questioning the necessity of some of the present doctoral programs in the mathematical sciences. Other articles include details of the organization and the members of the Policy Council of the National Institute of Education and a description of the Second U.S.A. Mathematical Olympiad. (DT)

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Newsletter

Conference Board of the Mathematical Sciences

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Vol. 8, No. 4 October 1973

CONTENTS

Page

... 1
... 2
... 4
... 5
... 6
... 7
... 8
... 10
... 11
... 12
... 13
... 14
... 16

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SOME REALITIES FOR MATHEMATICIANS, PRESENT AND FUTURE

[The article below, by Chairman Robert E. Gaskell of the Committee on Corporate Members of the Mathematical Association of America, is based on his presentation at the panel discussion Beyond Academe: The Mathematician in the Real World held during the recent summer mathematics meetings in Missoula, Montana.--Ed.]

In 1941, Thornton C. Fry, of Bell Labs, reported that there were about 150 mathematicians then working in industry, and that a need for an additional ten per year could be foreseen. Although Fry expected an increase in complexity of problems to be encountered, he expected that better training of engineers would provide the necessary talent. And he went even further to say, "Unless the qualifications of the mathematicians rise progressively with those of the engineers, it may turn out that less, rather than more, (mathematicians) will be employed." Apparently in contradiction of Fry's prophecy, in the succeeding 25 years growth of industrial employment of mathematicians was astonishing. Projections of the number of mathematicians to be required for the future reached astronomical proportions; expansion became the way of life for mathematics departments all over the country. And then the bubble burst! Why?

In this connection it is enlightening to study comments provided to the Committee on Corporate Members of the MAA by heads of industrial and government mathematics groups, responding to a letter sent out in early 1972. Avoiding the format of a questionnaire, the Committee sought and received very extensive, frank and thoughtful comments on the nature and practice of industrial mathematics that deserve the attention of all mathematicians and mathematics departments. A substantial fraction of these comments may be found in the Committee's report*, which is expected to appear in the American Mathematical Monthly next summer. A much smaller sample of these comments is given in the present article. Let me emphasize that these comments are from people who have spent many years in industrial and non-academic mathematics, each having achieved supervisory rank, and in some cases, vice-presidencies. They hire (and presumably fire) mathematicians. It is their job to judge and select the talent necessary to do the work that must be done, and then subsequently to evaluate the performance of the people they select. They have no mathematical specialty to sell; they must judge the need for all mathematics in their companies.

In 1941, Fry noted that "Industrial mathematics is being carried on by graduates of engineering and physics not so much because of the value of that

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*The Industrial Mathematician Views His Profession," by R. E. Gaskell and M. S. Klamkin, available on request from the Executive Director, Mathematical Association of America, 1225 Connecticut Avenue, N.W., Washington, D.C. 20036. Following is a list of those industrial and government groups whose mathematicians are quoted in the report: Aerospace Corporation, American Can Company, Bell Laboratories, Boeing Computer Services, Inc., Communications Satellite Corporation, Cornell Aeronautical Laboratory, E. I. DuPont de Nemours and Company, Federal Electric Corporation, General Electric Company, George C. Marshall Space Flight Center, GTE Sylvania, Inc., Investors Diversified Services, Inc., Kappa Systems, Inc., Lawrence Radiation Laboratory of the University of California at Berkeley, Lockheed Palo Alto Research Laboratory, Marathon Oil Company, Martin Marietta Corporation, National Security Agency, Naval Air Systems Command, Naval Research Laboratory, Olin Corporation, Phillips Petroleum Company, Rand Corporation, Sperry Rand Univac Division, Vought Systems Division, Westinghouse Electric Corporation.

training as because of the weakness of mathematical education in America." And so we wonder, "Are mathematicians today getting what they need to go into industry?" Here are some sample comments.

> In the past we had to hire personnel with pure mathematics training and retrain them because it was impossible to find enough personnel with the right kind of training. ... This process is obviously rather inefficient and it appears not necessary in the present and anticipated near future job market situation.
>
> Mathematicians, in my experience, have been retrained to work in some other area other than pure mathematics. ... They do not use mathematics directly, but the discipline and logic which they have learned through their training is a valuable part of their usefulness to the company.
>
> In my opinion mathematicians do not fit well into the industrial picture, especially the Ph.D. To be successful most people with mathematical training are retrained to work in another area, or have to become competent in another area. In our department, which employs most of the graduate trained mathematicians in the company, it is necessary to learn some engineering, especially if you are a Ph.D. Almost without exception Bachelor and Master Mathematicians become computer programmers.

So it appears that mathematicians in industry are frequently retrained to fill shortages in the supply of other technically trained personnel. Evidently the mathematician has learned how to learn. If he possesses a certain innate adaptability, a quality not nourished by present methods of mathematical education, his ability to learn quickly will be a major asset. These next comments bear this out.

> The mathematician entering industry cannot expect to "perform research." He must be prepared to solve other peoples' problems, not those which he generates himself.
>
> It has been my experience that unless a mathematician has (or acquires) a good background and understanding of the fields in which he applies his mathematical training he is not apt to be very successful in his efforts, and consequently his contributions are not always well appreciated.
>
> Mathematicians must be able to adapt themselves to any branch of the sciences of interest at the moment to their employer.
>
> As far as I know, there are almost no mathematicians in industry doing research in mathematics, at least not as the academic mathematician would see it. We do have plenty of mathematicians using their math as a tool to do research in other fields. Even more use a little math and a lot of the discipline and habit of thought in their performance as problem solvers.

There were many comments on the relative value of different areas of mathematics:

> I think that nearly all applied mathematics depends on these areas:
>
> 1. Probability
> 2. Statistics
> 3. Design of Experiments
> 4. Operations Research
> 5. Classical Analysis
> 6. Numerical Analysis

> It is important for an applied mathematician to be strong in one of these fields, and it is better if he is proficient in two or more, and he should be acquainted with the potentials of all of them. If all his training is in algebra or topology (as mine originally was) then he can eventually become useful, but only by taking the time to become good at one or more of these fields. I would not hire such a person unless others were unavailable.

> Many mathematicians (perhaps the majority) are not adequately trained for industrial work. ... As for the Ph.D. mathematicians, since 70%-80% receive their special training in abstract fields, such as topology, algebra, number theory, etc., most of these people are completely unsuited for industrial positions commensurate with their training.

> The mathematical training of the mathematician entering industry with a bachelor's degree, and usually even with a master's degree, is not adequate for the kind of work he is expected to be able to do and should be able to do. The engineer, on the contrary, with the same level of training in his field, usually knows more mathematics than the mathematician in that he is aware of and can use a broader spectrum of mathematics.

> So far as college mathematics and to a certain extent high school mathematics are concerned, the curricula are so dominated by pure mathematicians (set theorists) that students are often discouraged from pursuing the applied fields or find difficulty in finding appropriate courses.

> The push toward "near term relevance" in our research programs has made it virtually impossible for us to afford the luxury of a topologist, an algebraist ... we can no longer afford an impractical dreamer.

How difficult is it to get appropriate training in a mathematics department?

> Students who wish to increase their facility in applied mathematics while at a university have found it necessary, in my experience, to resort to special courses set up by the engineering school or graduate chemistry and physics departments in order to obtain their training.

> I am surprised how difficult it is to get a bachelor's degree in mathematics without studying abstract algebra but how easy it is in many schools to get through with little or no statistics.

> The curriculum should include at least one course, seething with examples, showing how modern mathematics interfaces with engineering, the physical sciences, the biological sciences and to the degree possible, the social sciences and humanities.

Other comments reflect the need to take responsibilities beyond the area of mathematics. Here is just one of many comments bearing on this requirement.

> In order for a mathematician to have effective communications with management, it is his responsibility to translate management's problems into a technical statement and find a solution to that statement through the use of his own unique training. However, most of our graduates are not prepared to take the next step, that of translating the solution back into the language generally used and understood by management. Without this skill, the mathematician is not able to perform a useful function for his company. (cont. on next page)

There is strong indication here that mathematicians selected for non-academic work in the future will have significant training in other fields, or at the very least they will have the attitude and versatility required to learn other fields quickly. Perception of opportunities for application of mathematics will still be of very great importance, as it was for those mathematicians who moved into such areas as operations research 25 years ago. Keen competition will come from mathematically talented individuals attracted to other departments "closer to the action," such as electrical engineering, operations research, and computer science. I need not discuss at greater length the implications of what has been said. To be honest, however, every mathematics department should apprise its majors of the views of employers they may interview, or the type of mathematical education they may someday be called upon to give.

-- Robert E. Gaskell

ICM, IFIP TRAVEL GRANTS, OTHER NRC DIVISION ACTIVITIES

For many years the National Research Council's Division of Mathematical Sciences has administered travel grant programs for the quadrennial International Congresses of Mathematicians (ICM) and the triennial Congresses of the International Federation for Information Processing (IFIP). As a result of the vagaries of history and the number twelve, two congresses will be held during 1974 -- both ICM and IFIP 74. The ICM will be held August 21-29 in Vancouver, Canada. The NRC program will expect to make travel grants to about 80 U.S. mathematicians. Because many senior mathematicians will have funds to attend the Congress, the NRC program is aimed primarily towards younger mathematicians. It has been announced that at least 60% of the awardees will be 35 or younger at the time of the Congress. IFIP 74 is scheduled for August 5-10 in Stockholm, Sweden. The triennial IFIP Congresses and exhibitions are a major international medium for exchange of information among developers and users of information processing techniques and technology. Funds already received by the NRC from the National Science Foundation will be sufficient to support the travel of 65 people to IFIP 74. The Division hopes to receive further funds from government agencies and private sources. Selection of the grantees will be made by two special committees to be established by the Division, one for each program. *Applications for these travel grants may be obtained from the Division of Mathematical Sciences, National Research Council, Washington, D.C. 20418. The Division's deadline for receipt of completed applications is December 31, 1973.*

Annually in the early fall the Division issues two regular publications, its Annual Report and its Fellowship Brochure. The Annual Report of the Division of Mathematical Sciences for the period July 1972 -- 1973, just published in September, contains a new section of general information about the National Academy of Sciences, the National Research Council, and the Division for those who wish to have a broad understanding of the organization. The Report also covers activities of the Division and its various committees during the year and includes a directory and address list of members of the Division and its committees. The Division's annual brochure Fellowship and Research Opportunities in the Mathematical Sciences, which was also published recently, calls attention to a number of fellowships and other kinds of support for research in the mathematical sciences at both the predoctoral and postdoctoral levels to be awarded during the year 1973-74. Copies of both the Annual Report and the Fellowship Brochure are available free upon request from the Division.

The Committee on National Statistics of the Division of Mathematical Sciences (March 1973 CBMS *Newsletter*, page 11) has been requested to design two

programs and submit project proposals for them. The first project, a one-year Study on Methodology for Setting HEW Statistical Priorities, was requested by the HEW Office of Program Systems. This study, which is seen by the Committee as a managable forst approach to a more general problem, aims to identify the best methods HEW could use to decide what statistics it should collect. A project proposal was sent to HEW during the summer and is now under consideration by that agency. The second request was directed to the Committee by the National Criminal Justice Information and Statistics Services of the Law Enforcement Assistance Administration (LEAA). A sample survey has been developed by LEAA designed to measure the incidence and circumstances of certain crimes, and a National Crime Panel is being set up by the Bureau of the Census to conduct this survey for LEAA. LEAA has asked the Committee to conduct a two-year evaluation of the National Crime Panel survey. A project has been designed for this and a formal proposal to LEAA is in preparation.

-- Thomas R. Kramer, Executive Secretary
NRC Division of Mathematical Sciences

LOWELL PAIGE TO HEAD NSF EDUCATION DIRECTORATE

On August 6 the White House announced President Nixon's nomination of mathematician *Lowell J. Paige* to be Assistant Director of the National Science Foundation for Education, and on October 11, as the CBMS *Newsletter* goes to press, this nomination has just been confirmed by the Senate. It is expected that Paige will be sworn in shortly and that he will, in the words of National Science Board Chairman Herbert E. Carter, "bring to the Foundation the thoughtfulness of the distinguished mathematician, the concern of the dedicated educator, and the discipline of the experienced administrator."

A graduate of the University of Wyoming, Paige received his doctorate in mathematics from the University of Wisconsin in 1947. His subsequent professional career has been primarily at the University of California at Los Angeles, where he has held the rank of Professor of Mathematics since 1962 and has been Chairman of the Mathematics Department from 1964-1968 and Dean of Physical Sciences since 1969.

PROPOSALS INVITED FOR NSF-CBMS REGIONAL RESEARCH CONFERENCES

The National Science Foundation announced on July 16 that it is seeking proposals for five-day regional conferences on subjects of current research interest in the mathematical sciences. The conferences are to be held during the summer of 1974 or the succeeding academic year. Each conference should plan for a single principal guest lecturer and about twenty-five participants. Topics for conferences may be from pure mathematics or from fields such as applied mathematics, statistics, computer science, operations research and management science.

Inquiries regarding details of proposals for these regional conferences may be addressed to the Conference Board of the Mathematical Sciences, 834 Joseph Henry Building, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037. *Proposals by prospective host institutions should be sent directly to the Mathematical Sciences Section, (attention Dr. William H. Pell) National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550, and should be received by 1 December 1973.* Proposals will be evaluated by a panel of the Conference Board and awards of conference grants will be made by the National Science Foundation with the advice of the panel.

JOHN TUKEY AWARDED NATIONAL MEDAL OF SCIENCE

John Wilder Tukey, who is both professor of statistics at Princeton University and associate executive director of the Research-Communications Principles Division of Bell Telephone Laboratories, was among eleven scientists to receive, in a White House ceremony on October 10, the 1973 National Medal of Science, the Federal Government's highest award for distinguished achievement in science, mathematics and engineering. Tukey was cited for his outstanding studies in statistics. Elected to the National Academy of Sciences in 1961, he has served on the President's Science Advisory Committee and as chairman of its panel that in 1965 produced a pioneering report on environmental pollution.

WINTER MEETING TO FEATURE PANELS, ADDRESSES OF UNUSUALLY WIDE APPEAL

Several panel discussions and addresses at the coming winter mathematics meeting of January 15-19 in San Francisco will be concerned with topics in applications, teaching, and problem solving of exceptionally broad interest. On the afternoon of January 17 a panel discussion on Mathematics and Society sponsored by the Conference Board of the Mathematical Sciences and organized and moderated by President Donald L. Thomsen, Jr. of the SIAM Institute for Mathematics and Society will feature four addresses: Biological, Social and Cultural Evolution, by Dr. Luigi L. Cavalli-Sforza of Stanford University Medical School; Mathematical Approach to Ecosystem Problems, by Dr. Simon A. Levin of Cornell University; Discrete Mathematics Applied to Environmental Problems, by Dr. Fred S. Roberts of Rutgers University; and Deployment of Emergency Vehicles, by Dr. Jan M. Chaiken of the RAND Corporation.

On the morning of the same day there will be two successive panel discussions. The first of these, sponsored jointly by the American Mathematical Society and the Mathematical Association of America, is to be on The Problem of Learning to Teach and will have as moderator Professor Henry L. Alder of the University of California at Davis and as panelists, Professors Paul R. Halmos of Indiana University, Edwin E. Moise of Queens College of CUNY, and George Piranian of the University of Michigan. The second, sponsored by the MAA, is on Problem Solving. It will be moderated by Dean Lester H. Lange of San Jose State University and will have four panelists: Dr. Murray S. Klamkin of the Ford Scientific Laboratories and Professors A. P. Hillman of the University of New Mexico, George Polya of Stanford University and J. E. Wetzel of the University of Illinois.

Retiring MAA President Victor Klee's address on the morning of January 18 will be on the subject of Interval Graphs and Allied Systems, with Relations to Molecular Genetics, Psychophysics, Archeology, Ecology, and the Inversion of Sparse Matrices. The MAA session for the morning of January 19 will consist of three invited hour addresses on applications of mathematics to the biological sciences: Mathematics in Pulmonary Physiology, by Professor J. W. Evans of the University of California at San Diego; Graphs and Molecules, by Professor Joshua Lederberg of Stanford University; and Manifolds, Machines, Models and Computability, by Professor Hans Bremerman of the University of California at Berkeley.

NEW SMC SURVEY OF SALARIES IN SCIENCE AND TECHNOLOGY

Issued in August, the Scientific Manpower Commission's *Salaries of Scientists, Engineers and Technicians (Sixth Edition)* is now available at $7.50 prepaid or $8.00 billed from SMC, 1776 Massachusetts Ave., N.W., Washington, D.C. 20036.

SECOND MEETING OF COMMITTEE OF SCIENTIFIC SOCIETY PRESIDENTS

A Committee of Scientific Society Presidents (CSSP), formed last spring on the initiative and invitation of President Alan C. Nixon of the American Chemical Society, held its second meeting on October 6 at ACS headquarters in Washington, D.C. The Committee was created to identify issues of broad concern to the professional scientific community and, where desirable and feasible, to stimulate concerted action on such issues. The October 6 meeting was attended by representatives of approximately twenty scientific societies, including President Saunders Mac Lane of the American Mathematical Society, President Ralph P. Boas of the Mathematical Association of America, Past-President Burton H. Colvin of the Society for Industrial and Applied Mathematics (representing SIAM President C. C. Lin) and Executive Director Truman Botts of the Conference Board of the Mathematical Sciences (representing CBMS Chairman William J. LeVeque).

The meeting opened with a report and discussion by those who had been present at a September 10 meeting of about twenty-two representatives of scientific and engineering societies convened by National Science Foundation Director H. Guyford Stever in his capacity as Science Advisor to the President. There was praise for Dr. Stever's calling of that meeting, as reflecting a conscientious effort to interact effectively with the professional scientific community. Such interaction was seen as increasingly important now that the White House science advisory apparatus has been largely dismantled, marking a new low in the influence of science in government (January 1973 CBMS *Newsletter*, pages 3-4). It was reported, however, that there was not much opportunity for feedback to Dr. Stever from attendees at the September 10 meeting, and the hope was expressed that at future such meetings there could be more.

Among matters receiving attention at the October 6 CSSP meeting were: problems of manpower and employment, some energy studies proposed to be carried out by the American Physical Society some guidelines for employers published by the American Chemical Society, and some issues of international copyright. The most urgent single issue addressed, however, was that of the range of critical national problems for whose solution major contributions from science and technology will be required, and the consequent need for a strong focus of some permanence within the federal government for the input of scientific and technological information and advice. After considerable discussion the following statement and resolution were adopted without dissent for transmittal to the President and release to the public:

> Major problems facing the people of the United States increasingly require the effective utilization of science and technology. It is essential that all levels of government have a continuing source of scientific and technical information and advice. For example, the energy crisis, food supply, and preservation of environmental quality, require scientific and technical solutions. The resolution of these problems demands the integrated action of the various subdivisions of science now partially represented in various departments, and day-to-day contact with Congress and the White House.
>
> Be it resolved, that in order that the government be provided with the best scientific and technological information and direction, the Committee of Scientific Society Presidents urges a step such as creation of a Department of Science and Technology, the establishment of a Council of Science and Technology in the White House, or the elevation of the position of the Science Advisor to cabinet rank.

E D I T O R I A L

IS THIS DOCTORAL PROGRAM NECESSARY?

In the United States and Canada there were about 250 new Ph.D.'s in 1952 in the Mathematical Sciences. In 1972 there were about 1,400. This startling increase came about through a variety of causes: The reaction to Sputnik, the recommendations of government bodies, as in the notorious Gilliland report, the enthusiasm for training more scientists and engineers to support the thrust into outer space, the prediction, by COSRIMS and others, of an intense need for more teachers of Mathematics, the development grants offered by the National Science Foundation, and just plain unreasonable desire to start up new Ph.D. programs.

At present many of the new Ph.D.'s have great anguish and trouble in finding positions reasonably related to their training; there are some (150 this summer, by a reasonably careful estimate) who have searched for such positions with no success. In time the news of these difficulties will get back to the beginning graduate students and even to mid-course students: Some will not start and others will give up; still others will continue but with a clearer expectation, knowing that they are studying Mathematics for its great beauty without sure prospects of their own subsequent employability. Thus in time, as in other human affairs not subject to detailed planning, supply will probably adjust itself to demand -- but only at the cost of considerable personal hardship. Under these circumstances, it is only appropriate that those responsible for Ph.D. programs -- professors, directors of graduate study, chairmen, and deans -- ask themselves some hard questions: Is our Ph.D. program necessary?

Here is a possible check list of specific questions.

1. The Ph.D. testifies that its holders have made an original contribution to knowledge; the degree is granted because of the hope that its recipients will go on to make additional and more fundamental contributions. Not all Ph.D.'s succeed in this, but any Ph.D. program, after 10 or 15 years, should have some graduates who have really done outstanding work. How many can you list for your program?

2. Outstanding research work is stimulated by visible previous outstanding work. Does the faculty of your program exhibit this? It is not hard to find out: Name the outstanding papers they have written and the reasons why they are outstanding, and specify the national and international invited addresses given by members of the faculty.

3. Adequate graduate work requires a multiplicity of prospects for research: Not just some long list of topics, but a real variety of promising fields of research, with enthusiastic faculty for each. Does your program provide this?

4. Sometimes graduate programs were established at prosperous times for what might now appear to be the wrong reasons. Were the following some of the reasons for your program?

(a) Graduate programs often provide teaching assistants to conduct undergraduate courses. How good are your teaching assistants? Are they chosen for their teaching ability or because they need the financial support? How much do they teach; can it be that they are exploited? Does your program exist in part in order to provide graduate assistants?

(b) Faculty members like to have graduate students, and this for a variety of reasons, some good, some bad. It is sometimes asserted that a research program will go well *only* if students are taking part. If this is really so, each tenured member of the faculty active in research would be likely to "turn out" a Ph.D. every three years or so. With a research career of 30 years, this means that *five to ten* new Mathematicians will grow for each present one. Does this make a case for population control? Is your program there chiefly in order to attract faculty? If so, are there alternatives?

(c) Innovation is the order of the day, and rightly so. Graduate training should be reformed to give the student a better feel for his future teaching, a wider grasp of Mathematics, and a better understanding of some of the applications. Sometimes Ph.D. programs are set up *in order to* make such a reform. Was your program the child of reform? Is this really an adequate reason for a new program?

(d) Was your program established for institutional prestige or for the economic advancement of your region of the country? If so, are these reasons adequate ones and are they really compelling?

5. Do your students know where they are going? Are they aware of the variety of other universities with graduate programs, of the multiplicity of fields of research, and of the uncertain prospects of professional employment? Do you help them to see the situation fully?

6. Mathematical research today is producing brilliant solutions of many basic problems. For example, just in one recent week I learned of three remarkable advances: Deligne's solution of the Weil conjectures (with a consequent solution of an old problem of Ramanujan), the Boone-Higman characterization of finitely generated groups with a solvable word problem, and Graeme Segal's elegant conceptual proof of the result of Nishida, that the stable homotopy ring is nilpotent.

Do your graduate students know enough to recognize these problems and so take part and pleasure in the advances of Mathematics? A real graduate training provides access to the beauty and wonders of Mathematical structures. Does your program do this? If there is doubt, ...

-- Saunders Mac Lane, President, American Mathematical Society

NATIONAL INSTITUTE OF EDUCATION: ORGANIZATION AND POLICY COUNCIL

In June 1972 a new governmental agency, the National Institute of Education (NIE), was established within the Department of Health, Education and Welfare to sponsor research and development projects at all levels of education. Last fall, Dr. Thomas K. Glennan, Jr. was appointed Director of NIE and Dr. Emerson Elliott Deputy Director. In January 1973, NIE issued its first announcement of programs of research support (see the January 1973 CBMS *Newsletter*, page 3, and the references there to earlier issues). NIE was created expressly to further Congressionally declared objectives of helping to solve or to alleviate the problems of, and promoting the reform and renewal of, American education; advancing the practice of education, as an art, science, and profession; strengthening the scientific and technological foundations of education; and building an effective educational research and development system.

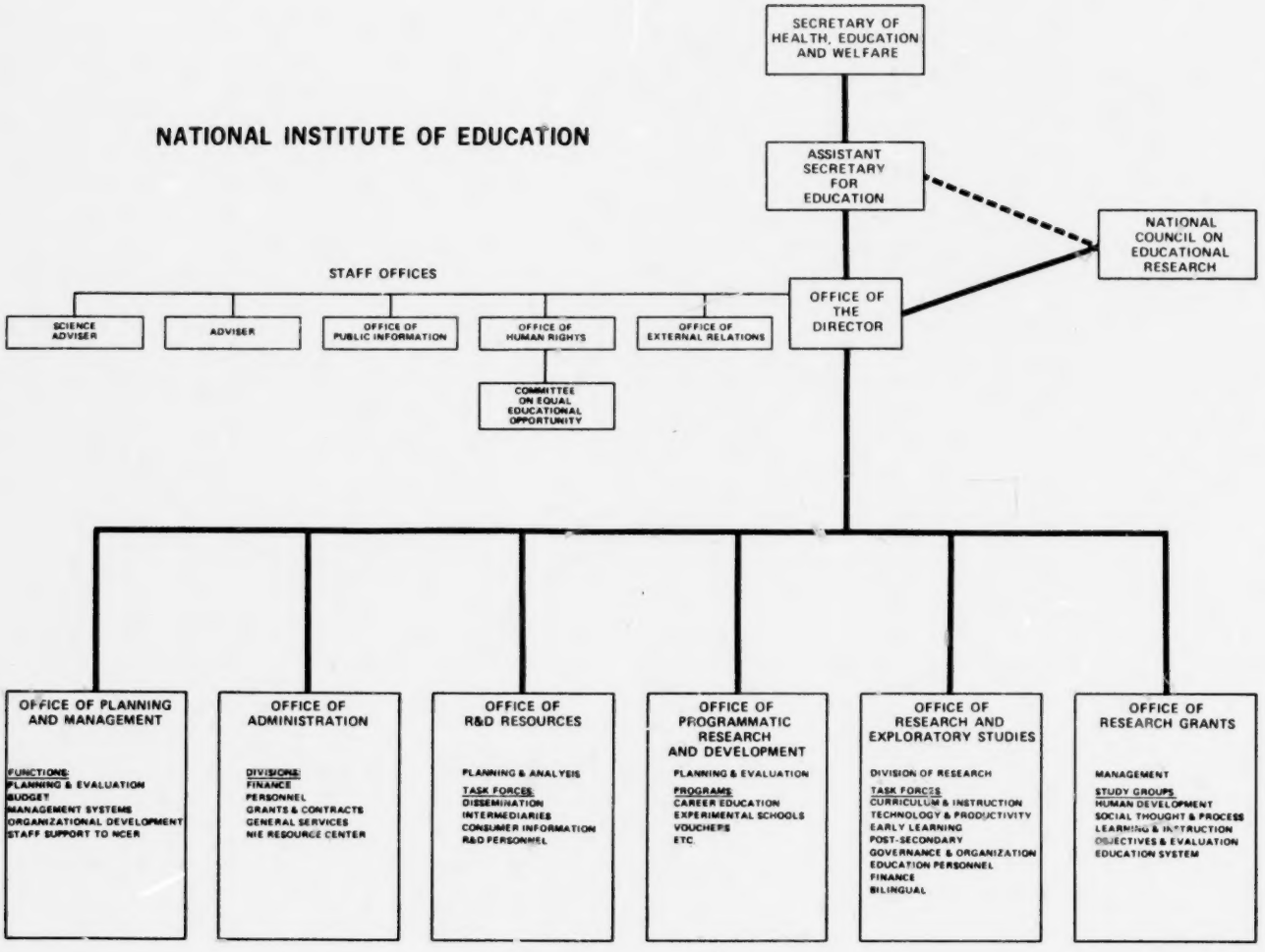
An initial organizational framework for NIE has now been set up in some detail, as shown in the chart on the facing page. A fifteen-member National Council on Educational Research is responsible for establishing general policy and reviewing the conduct of the Institute. Specific decisions about programs, initiatives, and funding are the responsibility of the Director, aided and advised by several Staff Offices as shown. (Of these, the Office labelled simply "Advisor" is concerned with legal and administrative advice, especially on Federal statutes affecting NIE performance.) In addition to the two Offices concerned with the Institute's own planning, management and administration, there are four Offices for carrying out Institute functions. The Office of Research and Development Resources is responsible for analyses, policies and programs designed to assure a strong R & D system in education and an effective system for disseminating research findings to practitioners and ultimate users. The Office of Programmatic Research and Development is concerned with time-limited programs of two sorts: relatively short programs oriented toward development and demonstration and programs of longer duration devoted to research on a particular problem or education topic. The Office of Research and Exploratory Studies consists of a Division of Research, which is concerned with the evaluation of education policy options open to government decision makers, and a number of time-limited Exploratory Task Forces for preliminary exploration and pre-program development.

The Office of Research Grants is of particular interest to the professional community in science education, since it is this Office primarily that supports field-initiated fundamental research over a broad range of education-related topics, on the basis of scientific merit and relevance to the reform and improvement of education. In addition, Study Groups within this Office conduct continuing reviews and syntheses of education-related research findings. These syntheses are evaluative in nature and provide a basis for the selected stimulation of field-initiated research, and for the planning of more directed NIE research efforts. Dr. John Mays, who is the Science Advisor to the Director of NIE, is at present also acting as the Associate Director of NIE for the Office of Research Grants. Guidelines for applying for research grants are being issued around mid-October, after which they may be obtained on request from the Office of Public Information, National Institute of Education, 300 Seventh Street, S.W., Room 628, Washington, D.C. 20208. Researchers are being asked to submit prospectuses by November and formal proposals by January, with grant awards to be made late in the spring.

On June 7 the Senate confirmed the President's nominees to the National Council on Educational Research (NCER), the general policy-making body for NIE. Chairman of the Council is Patrick E. Haggerty, who is chairman of the board of

(cont. on page 12)

NATIONAL INSTITUTE OF EDUCATION



Texas Instruments, Inc. Haggarty will serve a three-year term on the Council, as will Ralph M. Besse of the Cleveland law firm of Squire, Sanders and Dempsey, President John E. Corbally, Jr. of the University of Illinois, Principal Ruth Hurd Minor of the Locust School in Roselle, New Jersey, and President John C. Weaver of the University of Wisconsin System in Madison. Serving two-year terms on the Council are: President William O. Baker of Bell Telephone Laboratories, Superintendent Terrel H. Bell of the Granite School District in Utah, President Dominic J. Guzetta of the University of Akron, Chancellor Charles A. LeMaistre of the University of Texas System in Austin, and Chancellor W. Allen Wallis of the University of Rochester. Council members serving one-year terms include: Professor James S. Coleman of the Center for Social Organization of Schools at Johns Hopkins University, Director Vincent J. McColla of the Office for Aid to Nonpublic Education of the state of Pennsylvania, doctoral candidate Vera M. Martinez at the Graduate School of Educational Administration of the University of California at Riverside, Carl H. Pforzheimer, Jr. of the investment banking firm of Carl H. Pforzheimer and Company, and California Superintendant of Public Instruction Wilson C. Riles. The Council has met on August 6 and on September 17 and has established percentage guidelines for NIE spending, as follows: 10-15% to expanding knowledge about education, including the NIE research grants programs; 10-20% to strengthening the education R & D system; 65-80% to problem-solving activities and advancing the practice of American education. The Administration's 1974 budget request for NIE is $162 million, but present indications are that Congress will cut this, probably to under $100 million.

THREE SUMMER CONFERENCES HELD ON SCHOOL MATHEMATICS EDUCATION

This past summer the National Science Foundation supported three national conferences on mathematical education at the school level. The first and largest of these was a conference on the K-12 mathematics curriculum held June 21-24 in Snowmass, Colorado, under the direction of Professor George Springer of Indiana University. The second was a conference, less comprehensive in scope, on the middle school mathematics curriculum (especially grades 7 and 8) held June 16-20 in Orono, Maine, under the direction of Professor Earl Beard of the University of Maine. The third conference, devoted to a problem-solving curriculum for grades 6-9, was held September 9-12 in Cape Ann, Massachusetts, and was directed by Professor Uri Haber-Schaim of Newton College of the Sacred Heart.

The Snowmass conference involved fifty-five participants, including not only mathematicians, mathematics educators and school personnel but also persons from the fields of computer science, statistics, and the physical, biological and social sciences who had experience in curriculum work. Some of the needs relative to mathematics education that emerged from the discussions included: better communication between universities and schools; a new delineation of goals, taking account of societal needs; more effective and innovative pre-service and in-service training for teachers; a better understanding of mathematical problem solving and how children learn this; suitable materials at every grade level on significant applications of mathematics and statistics; a more widespread and effective role for computers in mathematical education, with computer literacy for all as one of its goals; and new directions and techniques in the evaluation of programs and student performance. Subgroups of the participants generated a number of more specific ideas and recommendations.

Both the Orono conference of some thirty persons and the Cape Ann conference of twenty-one persons were addressed primarily to problems of the middle school grades. The Orono conference devoted considerable discussion to ways of achieving a changed curriculum and adopted a principal resolution recommending

that NSF support a work-study group to study the K-10 mathematics curriculum with special emphasis on middle school problems. The Cape Ann conference was focused on the development of a middle-grade curriculum featuring problem-solving with an orientation toward the real-world problems of other disciplines, especially the social sciences. Position papers prepared by each of the participants and circulatediin advance formed the basis for the intensive plenary discussions of which the conference consisted.

PARTICIPANTS INVITED FOR SURVEY ON COMPUTER SIMULATION TECHNIQUES

On behalf of the TIMS College on Simulation and Gaming and the 1974 Winter Simulation Conference, a computer simulation survey is to be conducted during October/November. The survey will especialy concern itself with questions of the nature and level of course work in computer simulation, it being a matter of concern to teachers of simulation that no standard syllabus exists and that there seems to be no consensus as to just what constitutes an adequate simulation course of instruction.

Teachers and sophisticated users of simulation are invited to participate in this nationwide survey, and administrators of departments and organizations in which simulation techniques and instruction are vital topics are encouraged to have their activities and key personnel represented in it. Participants will be provided with a prepared questionnaire, and they will be supplied with a copy of the survey report upon its completion early in 1974. It is expected that the results of the survey will prove valuable not only to designers of simulation curricula, but to the larger Operations Research/Management Science/Systems Analysis community as well. Those interested should write immediately for a copy of the questionnaire to: Professor R. E. Beckwith, Graduate School of Business Administration, Tulane University, New Orleans, Louisiana 70118, giving name, organization, title or responsibility, and preferred mailing address.

LOGISTICS RESEARCH CONFERENCE TO BE HELD AT GWU

The Office of Naval Research and the George Washington University, with the cooperation of the Air Force Office of Scientific Research and the Army Research Office, announce a Logistics Research Conference to be held at the George Washington University, Washington, D.C., on 8-10 May 1974. The main objectives of the Conference are to survey major developments and difficulties in government, industrial and military logistics research and applications since World War II, and to assess outstanding current problems and promising new research techniques.

Areas of research activity of interest for the Conference have been categorized, as follows: 1) applications of mathematical programming; 2) applied case studies; 3) design of systems; 4) inventory systems; 5) data collection, representation, and analysis; 6) measurement of performance; 7) probabilistic methods; 8) production and procurement; 9) reliability, maintainability, and availability; 10) simulation; 11) statistical methods; and 12) transportation and scheduling. Contributed papers are welcome. Abstracts and inquiries may be addressed to Ms. Henrietta Jones, Department of Operations Research, The George Washington University, Washington, D.C. 20006 (Phone: 202/676-7504). Further information may also be obtained from Professors Anthony V. Fiacco (202/676-7511), W.H. Marlow (202/676-7503), or Henry Solomon (202/676-7521) at the University, or from Mr. Marvin Denicoff (202/692-4304 at the Office of Naval Research.

THE SECOND U.S.A. MATHEMATICAL OLYMPIAD

[The CBMS *Newsletter* is indebted to Nura D. Turner, a leading member of the U.S.A. Mathematical Olympiad Subcommittee, for the following article.--Ed.]

Following the success of the First U.S.A. Mathematical Olympiad held 9 May 1972 (October 1972 CBMS *Newsletter*, pages 14-15), the Second Olympiad was held on 1 May 1973. Invited to participate were the approximately 100 top-ranking students in the 24th Annual High School Mathematics Competition (AHSMC), held 13 March 1973, plus a number of students from the State of Michigan that does not take part in the AHSMC and non-winning students in the First Olympiad who were still in high school. The writing of the three-hour examination by a participant took place in his own school. The five essay-type questions comprising the examination are stated below.

1. Two points, P and Q, lie in the interior of a regular tetrahedron ABCD. Prove that angle PAQ < 60°.

2. Let $\{X_n\}$ and $\{Y_n\}$ denote two sequences of integers defined as follows:

   $X_0 = 1,\ X_1 = 1,\ X_{n+1} = X_n + 2X_{n-1}$ $(n = 1, 2, 3, \ldots)$

   $Y_0 = 1,\ Y_1 = 7,\ Y_{n+1} = 2Y_n + 3Y_{n-1}$ $(n = 1, 2, 3, \ldots)$

   Thus, the first few terms of the two sequences are:

   X: 1, 1, 3, 5, 11, 21, ...

   Y: 1, 7, 17, 55, 161, 487, ...

   Prove that, except for "1", there is no term which occurs in both sequences.

3. Three distinct vertices are chosen at random from the vertices of a given regular polygon of (2n + 1) sides. If all such choices are equally likely, what is the probability that the center of the given polygon lies in the interior of the triangle determined by the three chosen random points?

4. Determine all the roots, real or complex, of the system of simultaneous equations

   $$x + y + z = 3$$

   $$x^2 + y^2 + z^2 = 3$$

   $$x^5 + y^5 + z^5 = 3$$

5. Show that the cube roots of three distinct prime numbers cannot be three terms (not necessarily consecutive) of an arithmetic progression.

These questions were designed, as were those of the First Olympiad, to test the students' powers of abstract reasoning using the mathematical tools of elementary secondary school arithmetic, algebra and geometry.

The Olympiad program here in the United States is similar to those Olympiad programs of long establishment in the Eastern European countries and those of more recent establishment in the Western countries of Austria, Belgium, Canada, Israel, the Netherlands, South Africa, Sweden, the United Kingdom, and West Germany. The British have now held nine Olympiad competitions and for each of them have used

as a qualifying round in a particular year the questions of the AHSMC -- called the "American Paper" by the British -- for that year. We have followed suit by using our AHSMC as a qualifying round for the U.S.A. Mathematical Olympiad.

The eight top-ranking students in the competition were declared winners. Their names, with corresponding ranks, schools, and home locations are listed below.

Name	Rank	Grade	School	Location
Anick, David Jay	5	Sr.	The Ranney School	Neptune, N.J.
Arenstorf, Gerhard C.	3	Soph.	Peabody Demonstration School	Nashville, Tn.
Davis, Ernest S.	6	Jr.	Classical High School	Providence, R.I.
Hajek, Bruce Edward	7	Sr.	Willowbrook High School	Villa Park, Il.
Kirsch, Martin D.	4	Sr.	Grant High School	Van Nuys, Ca.
Katz, Sheldon	1	Sr.	Brooklyn Tech	Brooklyn, N.Y.
Lander, Eric S.	2	Jr.	Stuyvesant High School	Brooklyn, N.Y.
Rubin, Karl C.	8	Sr.	Woodrow Wilson High School	Washington, D.C.

Sheldon Katz and David Jay Anick participated in the First Olympiad. Sheldon ranked in the top 25 and David tied for fourth place.

There are similarities to be noted between the groups of winners of the First and Second Olympiads. The general locations from which each group came were the east coast, the mid west, and the west coast, the number from each location being, for the First Olympiad, four from the east, two from the mid-west, and two from the west; and for the Second Olympiad, five from the east, two from the mid-west, and one from the west. Not all winners were high school seniors: In the First Olympiad, one was a junior; in the Second Olympiad, two were juniors, and one a sophomore. For both Olympiads, the parents of winners tended to be professional people, and a fair representation of parents made the trip to the honoring ceremonies in Washington, D.C.: 10 parents or representatives of parents of First Olympiad winners; 9 parents of Second Olympiad winners. In each group no one has plans for a career in secondary school teaching. In each group there prevailed a strong feeling that winners could not credit their teachers with the attainment they had achieved in the use of creative ability in mathematics. No girls were among the winners in either the First or the Second Olympiad. The correlation between scores of winners on the Olympiad and the AHSMC was not significant in either the First or the Second Olympiad.

The honoring ceremonies for the Second Olympiad were more extensive than those for the First. The winners arrived in Washington, D.C. on June 26th and left in the late afternoon of the 29th. The morning of the 27th they were guests of the National Science Foundation where they were welcomed by Dr. Edward C. Creutz, Assistant Director for Research, saw a film on "The Life and Death of a Star", saw slides of the Antarctic that emphasized youth working in science, observed a demonstration of the teaching machine "Plato" and enjoyed a buffet lunch while playing with "Plato". The afternoon was spent at the National Museum of History and Technology where another especially planned program was provided by Dr. Uta Merzbach, Curator of Mathematics, and Dr. Sharon Gibbs, Visiting Research Scholar on Antique Instruments. The morning of the 29th the party of winners, parents, and committee members travelled for a second year to the National Bureau of Standards at Gaithersburg where they were entertained at luncheon, a tour, and lectures arranged by Dr. Burton H. Colvin, Chief, Applied Mathematics Division. Lectures on number theory and computers and remote interactive computing were given by Dr. Morris Newman and Mr. R. A. Kirsch, respectively.

(continued on next page)

The morning of the 28th, the day of the three-part Awards Ceremony, the group went on a tour of Washington. Late that afternoon the presentation of awards and the Second U.S.A. Mathematical Olympiad Address took place in the Board Room of the National Academy of Sciences. The Address, "Mathematics and the Future", was given by Professor Saunders Mac Lane, who is President of the American Mathematical Society and a past President of the Mathematical Association of America and was, at the time of the Ceremony, Vice President-elect of the National Academy of Sciences. Each of the winners then received a set of publications presented by the National Council of Teachers of Mathematics, a calculator presented by the Hewlett-Packard Company and an engraved silver tray and a $100 U.S. Savings Bond presented by the International Business Machines Corporation. These events were followed by a reception in the Reading Room of the Academy. The Ceremony ended with dinner in the Academy's Great Hall. The ceremonies associated with the awards presentations were made possible by a grant from IBM, a grant deeply appreciated by the members of the U.S.A. Mathematical Olympiad Subcommittee.

-- Nura D. Turner

CBMS COMPUTER EDUCATION REPORT AGAIN AVAILABLE

Recommendations Regarding Computers in High School Education, a report first issued in the summer of 1972 by CBMS as a result of a study conducted over a two-year period by its Committee on Computer Education with National Science Foundation support, has now been reprinted and is available free on request from the Conference Board of the Mathematical Sciences, 834 Joseph Henry Building, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037. The reprinting and distribution of this report, for which there has been a strong and continuing demand, has been made possible by a grant from the International Business Machines Corporation. As was noted in more detail in the May 1973 CBMS *Newsletter*, page 16, the report formed the basis for a panel discussion by three members of the Committee at the April 1973 annual meeting of the National Council of Teachers of Mathematics in Houston, Texas.

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